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Final dissertation

**Persuasive strategies embedded in games used by kids
and teens: A literature review**

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1. Abstract

The field of technology is rapidly growing and is applied to various settings in our everyday lives. The incorporation of persuasion within technology has been proven to be effective, and can be leveraged to alter the attitudes and behaviors of children and teenagers. This literature review focuses on the application of persuasive technology within games, and specific features that are able to have the most impact on attitudinal and behavioral changes. Persuasive Systems Design (PSD) has been used as a theoretical framework in order to characterize features across studies and sectors. It has been found that tailoring, self-monitoring, rewards, social comparison, and competition are the most optimal features for the encouragement of physical activity. For dietary health games, persuasive principles in the social support component were preferred by participants. Personalization made the experience of playing more enjoyable in self-management studies, and tunneling, self-monitoring, as well as rewards facilitated the preservation of learned skills. In the sector of education and learning, simulation was one of the strongest principles. In conclusion, social influence has a significant effect across all sectors, but proves to be more persuasive when combined with principles in both primary task support and dialogue support.

2. Introduction

Technology has become a major part of our lives. The incorporation of technology to daily pursuits has become common in our personal, professional, and academic lives. It has been proven to be a useful asset for a variety of ages, contexts, and purposes. Our world has become modernized and easily connected through these devices which are becoming normalized and easily accessible, especially during the upbringing of the younger generations. Children are now exposed to technology earlier on in life, and are constantly surrounded by different kinds of devices. They could be interacting with these devices as early as during their infancy (for example, parents giving infants their mobile phones to watch cartoons), or later on in elementary school where technology use has been implemented in education systems (for example, learning how to type or using an online platform for assignments or lesson management). They have also become a large part of teenagers' social and academic lives. Social interaction through texting or sharing personal information on platforms like Instagram and Facebook have become the new norm. Availability of information and resources that have been broadcasted online has generated a lot of attention, and has catered to millions of people that own technological devices. The impact technology has can be used to influence anyone, and is a great tool that can help encourage healthier habits, as well as create positive changes in childrens' lives. However, childrens' interest and engagement can be difficult to maintain, especially when the information or activity is perceived to be tedious. A questionnaire administered to children showcased that 98% of respondents perceived mobile games as enjoyable (Almomani et al., 2014). Another study also showcased that most children use mobile phones everyday, and some of them first used computers when they were as young as 4 years of age (Edwards et al., 2014). Using games and gamification can help engage students and motivate them to learn and maintain healthier habits. When tasks become more enjoyable to perform, they are more likely to participate in it.

Persuasive technology can be defined as the use of computing systems specifically designed with elements of persuasion: a strategy that, when applied, aims to change users' attitude or behavior (Fogg, 2003). Persuasion does not entail tactics

of coercion or deception, as the target attitude or behavior is attempted to be achieved through voluntary initiation of the individual. There are a multitude of advantages when implementing persuasive technology that can contribute to its increase of effectiveness such as: access, persistence, interaction, information processing, and versatility. Easy access to the devices means there is more opportunity for persuasion in regards to the timing and the location. Usually persuasive technology is embedded into a device that is easily portable or that can be constantly around the user (for example, an application on their mobile device). Its persistence is also an important factor to consider, as the amount of exposure to the persuasive elements can make it more likely for a specific behavior or attitude to occur. For example, at any time of the day and regardless of location, users can receive previously programmed notifications or reminders, as long as the device is within their proximity. Interaction with the technology can elicit feelings of being more involved (for example, responding to a prompt, or personalization of the feedback received). Another positive facet of persuasive technology is the ability to collect large quantities of data and organize information in a more efficient way. The application of persuasion into technology is versatile: it can be embedded into audios, texts, visuals (such as graphical representations), etc. These aspects can also be combined and embedded into a wide variety of platforms and devices such as websites, mobile phones, computers, Augmented Reality (AR), Virtual Reality (VR), exercise equipment, social media, etc. Moreover, this paper will focus on games and gamification, which is a specific type of persuasive technology.

Gamification is an approach used to influence users' motivation to perform certain tasks in non-game settings. The impact of gamification on motivation can be illustrated through an established framework called the Self-Determination Theory (SDT) (Ryan & Deci, 2000a). Based on SDT, there are two kinds of motivation: intrinsic motivation and extrinsic motivation. Intrinsic motivation can be described as the reasoning behind a certain behavior being driven by the individual's pleasure or enjoyment (Ryan & Deci, 2000b). Extrinsic motivation involves an activity being performed in anticipation of an expected result (Ryan & Deci, 2000b). Gamification uses game elements to invoke extrinsic motivation such as avatars, points, scoreboards, and badges (Deterding et al., 2011). The inducement of intrinsic

motivation can be achieved through competence, autonomy, and relatedness (Ryan & Deci, 2000a). Autonomy can be described as the perception that one is completing a task based on their own inclination. Competence is the belief that one can accomplish difficult or challenging tasks. Relatedness is the feeling of understanding and being understood by others, or sharing similar feelings or experiences. Competence is not strong enough to influence intrinsic motivation without feelings of autonomy. Relatedness and curiosity could be used to further promote it. Enhancing motivation is helpful when applied to contexts that can improve the wellbeing of the respective target population, or boost users' performance on tasks that would be beneficial for either them or their environmental surroundings.

The following section will discuss the methodology used in order to obtain the papers considered for this literature review. Section 4 will cover the underlying theories used in persuasive game designs. Section 5 will discuss the specific features that were meant to act as the persuasive elements of the games. Section 6 will identify the domains extracted from the research papers, conclude which game features are ideal for each domain, and indicate the main limitations of the research field.

3. Methods

The “PRISMA 2009 Flow Diagram” (*Figure 1*) has been used as a guideline in order to structure the search strategy as follows:

1. *Identification: the process of searching for articles through a database.*

In order to compile research papers relevant to the research topics, the database “Scopus” was used as the main resource. Through the setting “Article title, Abstract, Keywords”, there were three main components that were highlighted for the search approach: the use of persuasive technology, the implementation of persuasive technology within the context of games, and the age range of the participants (children up to teenage years). The topic of persuasive technology embedded in social media was also considered, but ultimately it was decided that the emphasis would remain on games. The procedure began with the development of three lists of keywords and their synonyms, each tailored to the three aforementioned components (*Table 1*). With the goal of finding articles that include all three components, the keywords were merged using the “advanced document search” section to “combine queries”.

Table 1: search strategy

Persuasive Technology	“persuasive strateg*” OR “persuasive technolog*”
Games	gam* OR “online gam*” OR “virtual gam*” OR “computer gam*” OR “laptop gam*” OR “mobile gam*” OR “tablet gam*” OR “ipad gam*” OR “digital gam*” OR devices OR phones OR smartphones OR “smartphone gam*” OR “phone gam*”
Age	kids OR teens OR teenagers OR children OR toddlers OR pupils OR students OR youth OR adolescents OR young*

2. *Screening: a brief evaluation of possible relevance.*

Each result was examined through reading the abstract, and additional criteria was applied to filter the articles further. Participants must have been up to the age of 18 (parent-toddler interaction was also included: toddlers would need parents’ mediation in order to use the technology). When age was not included in the abstract,

articles with the following descriptions were included: “teenagers”, “adolescents” (Cambridge English Dictionary’s definition: a young person who is developing into an adult). Certain terms that implied participants did not meet relevant age range standards were excluded such as: “young adult”, “undergraduate students”, “university students”, and “higher education”.

3. *Eligibility: advanced evaluation for eligibility of full inspection.*

Assessment of eligibility involved a brief skim of the remaining papers in order to determine which articles will be fully read and closely inspected for the literature review. Three additional criteria were taken account of for this stage: persuasive technology was referenced to be used in the context of games (or gamification features in apps or devices), studies included participants and results (excluded articles that are only design-based), and mixed age ranges (children or teenagers with adults) required the separation of their data.

4. *Included: articles that were read and included in the literature review.*

After careful deliberation of the 20 remaining papers, there were a few that were excluded for either lack of relevant information regarding the research topic or insufficient data. The total number of articles that are included in this literature review are 16.



PRISMA 2009 Flow Diagram

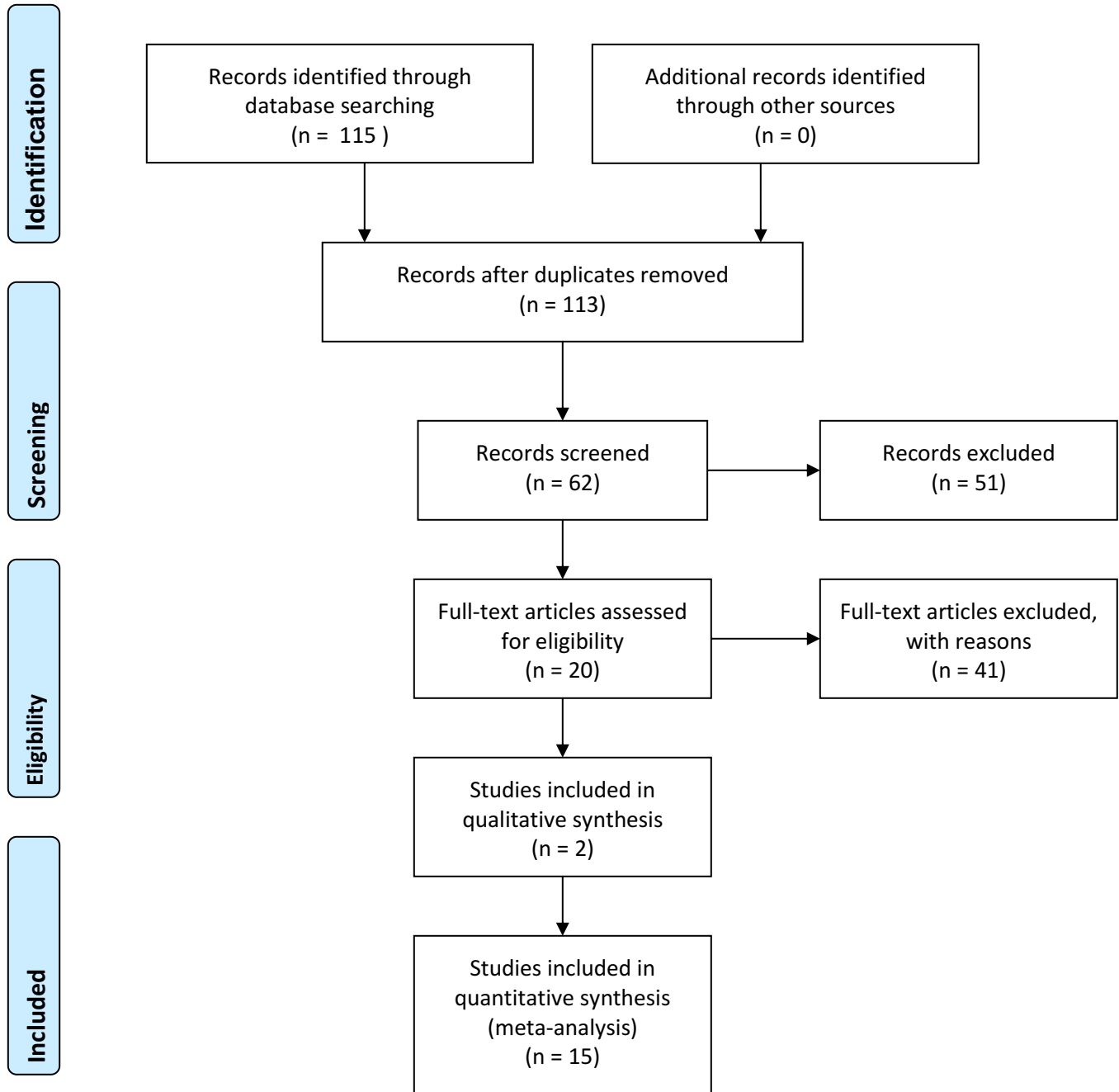


Figure 1: PRISMA Flow Diagram PRISMA flow diagram of search strategy (Moher, Liberati, Tetzlaff and Altman, The PRISMA Group, 2009).

4. Theoretical Frameworks

Game designs that aim to be persuasive follow certain theories in order to implement mechanisms within the game that could lead to achieving a target attitude or behavior. Each theory explains a viewpoint of the processes that occur when something is performed or an experience is encountered, guiding the authors to create a design that includes these processes based on what is attempted to be achieved. Although some of the papers used persuasive-based theories, most of the theories were not specifically designed for persuasion; however, they were meant to be used within game design to facilitate persuasion. Three additional categories of theories have been identified: motivational-based, behavioral-based, and learning-based. Through motivation, behavior change, or learning, the theories that seek to describe how these aspects work, and how they can be encouraged to develop in a player, are used as assumptions in game design. These changes are often prompted to occur with the intention of improving a certain aspect of a person's life. Some of the theories are well-known and established in the scientific field, and a few of them were new developments by the authors that consisted of a combination of characteristics that they believed were the most important and tailored to fit the goals of their specific study. This section compiles all the theories that underlie the game designs included in this literature review and introduces the reasoning behind using Persuasive Systems Design (PSD) as the main basis of game feature descriptions in this paper.

4.1 Motivational-based theories

It has been consistently proven over time that motivation has a strong impact on behavior. The requirement for motivation to be high in order for a behavior to occur has been implemented in many theories of both behavior and learning, as it is seen as a powerful facilitator for an individual to have the intention of doing something in order for it to be carried out. As previously mentioned, the Self-Determination Theory focuses on motivation specifically within gamification, however a more general theory will be introduced in this subsection, as well as theories designed for specific settings (a comparison is also made between two exercise-related motivational theories). Even

though they were designed for a particular purpose, they can also be generalized to other contexts.

Keller's ARCS is a framework that aims to outline the processes that lead to motivation (Keller, 1987). According to this model, there are four qualities that increase motivation: attention, relevance, confidence, and satisfaction. Attention is the attraction of one's interest, and the preservation of that interest so they can be engaged as they are performing the behavior. Relevance refers to the importance of the presented information to be applicable to the person's life. Confidence is the perception of how likely an individual believes they will succeed. Satisfaction indicates the sense of accomplishment that the person feels after completing the target task. When all four of these factors are present, it is considered plausible to assume that motivation is high.

Consolvo et al. (2006) proposed four design elements that aimed to increase motivation to engage in physical activity: a precise measuring device for the activity performed, updated feedback on progress, social interaction, and the consideration of users' lifestyle. Edwards et al. (2014) also suggested four characteristics to encourage exercise: portability and accuracy of activity monitoring gadgets, social support, goal setting, as well as incentives and rewards. These two theories focus on some similar aspects. Prioritizing accurate measuring devices of the exercise that is being performed was an important characteristic for both of them (in other settings, this could be considered as the accurate measurement of target tasks), as well as a segment within the device that allows support for social interaction. However, according to Consolvo et al. (2006), continuous presentation of the progression users have made, and the consideration of possible lifestyle constraints were also seen as significant aspects of game design. For Edwards et al. (2014), it was more important to include a section in which users can set specific goals to work towards, and to compliment that aspect by providing rewards.

4.2 Behavioral-based theories

Theories that describe behavior are usually focused on the reasons behind the behaviors we perform, which can lead to the prediction of aspects that can encourage,

or persuade, people to engage in target behaviors. Skinner (1938) proposed the theory of operant conditioning, which involves the application of reinforcement to encourage a target behavior, or punishment to discourage an unwanted behavior. This can be seen in gamification aspects such as rewards, which offer an incentive for completing a relevant task. These two established theories have been used in Premack's Principle states that pairing a behavior that occurs frequently with a behavior that occurs rarely can encourage the frequency of the latter behavior to increase (Premack, 1959). For example, encouraging a child to take their medicine (undesired behavior) by allowing them to have more dessert (desired behavior). The behavioral theories introduced below focus on transforming specific behaviors, and the final one in this subsection describes the general process of making permanent changes to one's life.

According to the attitude-social influence-efficacy (ASE) model, attitude, social influence and self-efficacy are predictors of behavior (de Vries, Dijkstra, & Kuhlman, 1988). The first factor, attitude, denotes that when one has a positive attitude towards a behavior, they are more likely to execute it. The second factor, social influence, emphasizes the importance of one's surrounding environment and the perception of what an individual believes society would find socially acceptable. The third factor, self-efficacy, is one's belief in their ability to carry out this behavior. In other words, when a person has a positive mindset towards a certain behavior, presumes their intentions to engage in that behavior are socially desirable, and has confidence in their capability to perform it, the likelihood of the behavior happening is relatively high.

Fogg's Behavior Model (*Figure 2*) is a substantial theory within the field that describes three aspects which determine whether or not a behavior occurs: motivation, ability, and triggers (Fogg, 2009). Behavior is more likely to take place when the person has high motivation to perform it, but also has the ability (qualifications, time, funds, etc.) to carry it out. In this circumstance, when both motivation and ability are high, the behavior should occur after the presentation of a prompt (trigger). After the trigger is perceived by the individual, it is taken as a sign that the behavior should transpire. If there is a lack of motivation (which would decrease the desire to engage in this behavior) or ability (not enough resources or skills to engage in the behavior), the

behavior is less likely to occur.

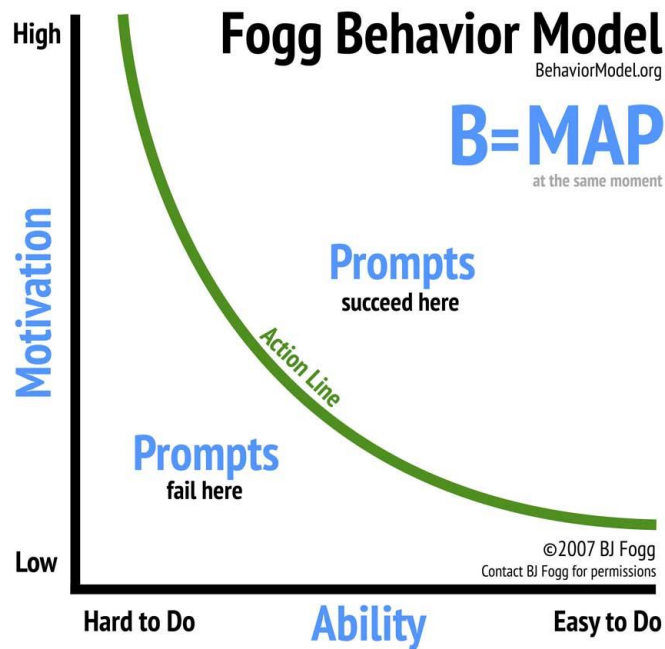


Figure 2: Fogg's Behavior Model

The Theory of Change aims to describe the different stages people go through when attempting to change habits or behaviors (Prochaska, Diclemente, & Norcross, 1992). It was originally designed to describe the stages of terminating addiction, but can be implemented to any kind of change that affects a person's life (for example, developing healthy eating habits). The five stages proposed are: precontemplation, contemplation, preparation, action, and maintenance. Precontemplation is the stage in which there is intention to change. Contemplation is the stage in which there is an awareness or thought process involving the idea of change, however there is no direct planning in how change will be accomplished. Preparation is the stage in which the individual starts organizing how they will arrange to make a change and the intention of change is increased. Action is when the change is actually occurring, and there is effort exerted in order to learn new habits. Maintenance is the final stage in which the behavior has been learned and performed for an appropriate amount of time, and the individual strives to maintain this behavior long-term.

4.3 Learning-based theories

The process of learning can be portrayed in numerous ways, and many theories have attempted to explain the components involved. The experiences we go through determine what we learn, and it can take place in many different forms. The theories that will be discussed below will consider the different routes of learning, which include: learning new knowledge or skills, improving or increasing skills or knowledge, and working to maintain a certain skill. The first theory focuses on the impact that both social engagements and the external environment have on children, as well as identifying the elements that could lead children to mimic (learn) the behaviors around them. The second theory focuses on developing, improving, and maintaining skills. The final theory of this subsection focuses on implanting learning content specifically into games.

The social learning theory proposed by Bandura (1977) suggests that children learn from their surroundings and imitate the behaviors of other people. There are four requirements that must be fulfilled for social learning to occur: attention, retention, reproduction, and motivation. Attention, in the context of this theory, means that children are aware of what's happening around them. Retention refers to the ongoing activation of memory regarding the actions being performed. Reproduction is the presence of ability that the child needs to have in order to perform the behaviors they are observing. Motivation refers to the desire of the children to perform the target behaviors.

A play-based occupational therapy model was introduced by Chang et al. (2008), and its main purpose was to increase motivation and improve skills (specifically, improving oral hygiene by encouraging children to brush their teeth and enhance their brushing skills). The three aspects that the design established were: increasing volition by making the game more entertaining, improving engagement for a better and more efficient performance, and automation to evolve the target behavior into a habit. In other words, their theory can be generalized to include three aspects: motivation, engagement (attention), and autonomy.

Game-initiated learning (GIL) takes three aspects into consideration in order to enhance education through games: gaming, discussing, and self-directed learning (Tsai et al., 2015). The theory is based on FBM, and meant to initiate the “trigger” aspect of the process (which is what directly signals the behavior to occur). There are three stages that are involved in GIL: gaming, discussing, and self-directed learning. The process begins with players being exposed to the target topic or skill through the game, and the aimed learning criteria immersed within it. The aspects of the game should spark conversation about the topic with other players, which would lead to sustained discussions. The final step is characterized by the motivation for players to learn more about the topic on their own time (outside the context of the game). This theory can be applied to any knowledge-based material, and is able to make the subject more interesting to learn (especially because this approach activates a more implicit learning style).

4.4 Persuasive theories

Some papers in the literature review were specifically focused on persuading the players that participated in their studies, and used persuasive-based theories for their game designs. The first part of this subsection presents a theory that explains the attributes that must be included in games in order for them to be successfully persuasive. The second part describes a set of persuasive principles that are broken down to describe themes in features within technology. When comparing persuasive game features across the other three classifications of theories (motivational-based, behavioral-based, and learning-based), there was no ideal theory that could describe the types of game features across domains and purposes. However, by using Persuasive Systems Design (PSD), they can be characterized in order to define trends within specific game features in the following section.

According to Ruggiero (2018), the mechanisms underlying persuasive games consist of: immersion, flow, engagement, as well as procedural rhetoric and ethos. Immersion is intense focus that simulates a feeling of being transported to the task that is being performed (Murray, 1997). Flow is when there is a high level of concentration and the player is submerged in the activity (Csikszentmihalyi, 1990). Engagement is

when the individual is captivated by what they're doing that they start internalizing the information without actively trying (Quinn, 2005). Procedural rhetoric was defined by Bogost (2007) as “using processes persuasively” and ethos by Evans (2011) as “persuasion by empathy, fact, and integrity”.

There are persuasive principles that target specific strategies and design components that have been used in the general field of persuasive technology (beyond games and gamification). The Persuasive Systems Design (PSD) model has recognized and organized these principles into four different elements to consider when designing persuasive technology: primary task support, dialogue support, system credibility support, and social support. (Oinas-Kukkonen & Harjumaa, 2009). The definitions of each grouping are generalized to any system within persuasive technology; however, they will be applied within the context of games in order to highlight relevance for this paper's topic. Within these four categories, there are certain principles of persuasion that work to support each section depending on the purpose. The classification of each principle can be found in *Table 2*, with each in its own respective category. Primary task support refers to the category that focuses on principles that can facilitate persuasion through the main aspects of the game. Dialogue support emphasizes the interaction between the game and the player, especially with principles that encourage the target attitude or behavior. Social support includes principles that promote social influence and social interaction, wherein other players can induce target attitude or behavior. System credibility support regards the features that help users believe that the information given by the system is reliable. Other principles of persuasion that were mentioned in the literature, but not identical to the terms used in PSD, have been defined and compared in *Table 3*. Terms that have an equivalent definition will be substituted with the names of the principles in PSD.

Table 2: Classifications of PSD (Oinas-Kukkonen & Harjumaa, 2009)

Primary Task Support	Dialogue Support	Social Support	System Credibility Support
Reduction	Praise	Social learning	Trustworthiness

Tunneling	Rewards	Social comparison	Expertise
Tailoring	Reminders	Normative influence	Surface credibility
Personalization	Suggestion	Social facilitation	Real-world feel
Self-monitoring	Similarity	Cooperation	Authority
Simulation	Liking	Competition	Third-party endorsements
Rehearsal	Social role	Recognition	Verifiability

Table 3: Principles of persuasion and their PSD equivalent

Principle of persuasion	PSD comparison	Description
Principle of cause and effect	Simulation	Directly witnessing cause and effect
Principle of attractiveness	Liking	Visually appealing
Principle of mobile loyalty	Tailoring, Personalization	Takes into consideration the types of users that will be interacting with the technology
Principle of just in time teaching	Suggestion	Gives suggestions depending on the time and the context
Principle of information quality	No direct equivalent	Gives updated and relevant information, which could be achieved by verifiability, third-party endorsements
Principle of convenience	No direct equivalent	Easy access

5. Persuasive features in games

This section will focus on the features that were included within the games in the literature. Each section will focus on a specific category within PSD: primary task support, dialogue support, and social support. Principles that comprise system credibility support were not directly mentioned to be used in any of the studies. This could be because of the target population's age (children), or that these studies have been conducted by scientists in universities, and parents believe they have credibility and expertise. For each of the three components, principles of persuasion will be defined and applied to game features that could be used in game design. The proposed features will represent these persuasive principles, focusing on the ones reported to be used in the relevant papers. It is important to note that not all principles in PSD will be covered in this review, only the ones that were included in the games of the studies.

5.1 Primary task support

The principle of reduction refers to the simplification of the game (or the system within the device that will display the game) so that tasks are more straightforward and easier to perform. This could be accomplished through the minimization of the buttons within the system so that playing the game is not a complicated task (Lakovic, 2020). The game itself can also be broken down into smaller, achievable levels (Elaish et al., 2019). This aspect can be encouraging, especially when there is large information or difficult goals that are aimed to be attained through the game.

The principle of tunneling involves directing players through a path in order to facilitate the target behavior or task. The main factor that should be recorded for tunneling is the user's performance, so that future adaptations of the game can be specific towards each player. Previous performance can lead to the modification of future content. This can be specific to difficulty level, or the emphasis on particular subjects. For example, vocabulary words in a language learning application were presented based on correct answers in order to expand practice for subjectively difficult words (Elaish et al., 2019). Following the players' ongoing performance in real time can also help guide behaviors or tasks while they are being produced (Chang et al., 2008).

Tailoring the system involves information rearrangement to suit the players' needs and interests. Obtaining relevant information of the player can help with system modifications in order to tailor features to their specific characteristics. For example, in a study conducted by (Berkovsky, Freyne, & Coombe, 2012), the player's experience was taken into consideration when administering rewards. In order to encourage participants to exercise, rewards for jumping while playing the game were increased to new players with the aim to maintain perceived enjoyment for them to keep playing. For the experienced players, rewards were decreased in order to encourage more physical activity. Tailored rewards were effective in increasing the physical activity performed, and therefore supports that this principle can be persuasive.

The principle of personalization involves keeping the information within the system user-focused. For example, a study aimed at teaching children diagnosed with diabetes knowledge about their disease included a robot that would ask them questions about their interests (Henkemans et al., 2017). Afterwards, they would use topics of interest previously mentioned by the children in order to generate a discussion involving personalized questions and information meant to improve their self-management. Personalized difficulty was another condition within the formerly mentioned exercise-motivating game (Berkovsky, Freyne, & Coombe, 2012). Difficulty levels were either increased or decreased depending on their performance. High performance would lead to increased difficulty and low performance would lead to decreased difficulty. This would increase the exercise for lower levels because they were adapted to become harder, and decrease for higher levels because they were adapted to become easier.

The principle of self-monitoring provides users with feedback on a regular basis in order for them to keep track of their accomplishments. While the player is attempting to achieve the tasks in the game, they are provided with updated reports on how they are performing (Edwards et al., 2014). This can come in different forms: for example, in a study intended to expand children's capabilities in brushing their teeth, both visual (displayed screen of areas brushed correctly) and audio feedback (diatonic scale) were made available to trace their progress (Chang et al, 2008). This can also be accomplished in groups of players, with all of them being aware of how they are

advancing collectively as teams (Reis & Correia, 2011). Self-monitoring can lead people to put in more effort in order to observe their improvement.

Simulation provides users with an experience that is meant for them to make a connection: it illustrates the relationship between two variables, especially cause and effect. A figure can be added to the game to symbolize what would happen depending on the players' choices. For example, Kroes & Shahid (2013) included a "mirror" within their study that presented the consequences of eating unhealthy snacks. Whenever participants would choose snacks over fruits, the "mirror" in the game would reflect unhealthy skin to showcase the potential result. In a smoking prevention mobile game, a visual representation of lungs progressively darkening would appear when players wouldn't reject cigarette boxes off the screen (Lakovic, 2020). It conveyed the potential irreversible damage that would likely occur after an individual decides to take up the habit of smoking. Another game meant to improve the attitude people have towards the homeless attempted to get players to virtually experience the difficulties of being homeless Ruggiero (2018). The game starts out with the player going through a difficult situation in life (no occupation or home as a single parent), and the goal is to manage this living situation with a limited amount of money. Features that embody the principle of simulation focus on the experience that players have while playing the game, and can help them apply the aspects learned through cause and effect to their own life.

5.2 Dialogue support

The principle of praise involves delivering encouraging remarks towards the player when the target behavior is performed. Game features that represent the principle of praise usually come in the form of positive feedback. When a player passes a level, for example, the system can be designed to respond with "well done" (Lakovic, 2020). When the game includes a form of testing (answering questions, for example), words of encouragement can be provided to let the players know they are on the right track. Phrases such as "You're winning, but I will do my best to catch up!" would not only elicit feelings of accomplishment in the player, but also encourage some competition (Henkemans et al., 2017).

The principle of reward is when users are awarded with something after completing certain behaviors. Rewards can come in the form of virtual coins and incentives that could be earned within the game (Berkovsky, Freyne, & Coombe, 2012; Kadomura et al., 2014). They are given to the players when performance is evaluated as satisfactory (Elaish et al., 2019; Tsai et al., 2015). Badges are also commonly used as rewards in games (Alsaleh & Alnanih, 2020; Joi et al., 2016). They are versatile in that they are able to identify different types of goals and award the players while informing them of the specific tasks they have achieved.

The principle of reminders is when the system prompts the user by helping them recall the target behavior they are being persuaded to perform. Usually it's given in the form of notifications to the player's technological device, reminding them of their goals or encouraging them to engage in target activities (Katule, Rivett, & Densmore, 2016). They can also be used to test players' knowledge and remind them of the information or skills they have acquired while playing the game (Joi et al., 2016).

The principle of suggestion proposes recommendations for the user, guiding them towards performing the target behavior. Usually this is given in the form of a tip, or a prompt that the player can consider (Kroes & Shahid, 2013). This can be illustrated by the game that was played between the child and the robot, which acknowledged their emotions and desire to continue playing the game (Henkemans et al., 2017). For example, the robot would tell the child: "I see you are a bit bored. Do you still want to play one more round?", which includes the recognition of the child's mood, as well as an option to address their wishes.

The principle of similarity aims to highlight aspects that remind users of characteristics of themselves that they perceive are important. When information is more relevant to players' lives, and game features are able to target certain elements or populations, there will be an increased interest to engage in the aspired activities. For example, the robot would ask the children about their likes and dislikes while interacting with them and learning more about their preferences, then would provide them with the option to adjust its features such as its eyes to the participant's favorite color (Henkemans et al., 2017).

5.3 Social support

The principle of social comparison involves the user's awareness of others' performance to allow comparison to their own performance. Leaderboards are usually the features embedded in games in order to allow for social comparison (Elaish et al., 2019; Guo et al., 2021). Top performers are identified and other players are able to track which people have the highest scores (this can also evoke competition). Players are also aware of the fact that other people are able to view their performance as well, and usually have the desire to surpass other peoples' scores. For example, in the study conducted by Edwards et al. (2014), it was an option to disable their score from other people's feed. Some participants expressed that they did not want to share their performance specifically when their numbers were considered to be low in comparison to other participants. It can be inferred from this that social comparison has a strong impact, and will be effective when implemented in games.

The principle of competition is meant to spark people's competitive nature. As demonstrated in the social comparison section, individuals naturally analyze their progress with others. And typically, players will want to score as high as possible, and this can be leveraged by including features that will stimulate that desire. Many papers included competition in their game design, and it was mainly in the form of a scoreboard. For example, in a study that included teams of beneficiaries (main users) and intermediaries (users that are directly interacting with the technology), eating healthier food (more fruits and vegetables) and getting more exercise (walking a greater number of steps) was the main objective for beneficiaries (Katule, Rivett, & Densmore, 2016). The main motivator for intermediaries was competition, and they would keep up with the scoreboard in order to encourage the beneficiary to perform even better so that they would rise against the other teams. It can be assumed that competition is considered to be persuasive and will make games more persuasive when they are administered.

The principle of normative influence generates peer pressure to perform the target behavior. When people are motivated or pressured by others, it can increase the likelihood of that person performing the behavior significantly. For example, the

classrooms in a school were in a competition against each other to decrease the amount of noise they made collectively. Students that had high motivation to win would tell their peers to lower the volume of their voice when the noise was getting too loud (Reis & Correia, 2011). As a result, the noise level would decrease due to these students mostly complying with others' requests. Social support is a strong component to include in games and highlights the affects social influence has on human beings.

6. Discussion and Conclusions

This section will discuss the most optimal features to include in games depending on the target sectors. Based on the literature, four sectors have been identified: exercise, dietary health, health management, as well as education and learning. Conclusions will be made according to the information that has been presented in this paper, and a discussion of the limitations that were faced, as well as possible recommendations will be provided.

The principles that promote physical activity include: tailoring, personalization, self-monitoring, rewards, social comparison, and competition. In the study conducted by Berkovsky, Freyne, & Coombe (2012), the participants played against virtual competitors and did not show a significant difference between their performance and the control group's performance. Competition is more likely to be effective with humans, especially when they are a part of each other's personal lives (Katule, Rivett, & Densmore, 2016). Social influence in general is more effective when people are closer to each other in their personal life. Group members with friendships had used the interaction feature throughout the study more than the group members that had no personal relation (Edwards et al., 2014). Tailoring was effective in increasing the physical activity performed, and when the game became more challenging, players seemed to be more encouraged to jump and in order to complete the levels (Berkovsky, Freyne, & Coombe, 2012). Positive rewards were seen as encouraging, and negative consequences were not popular (Edwards et al., 2014). Activity monitoring devices were viewed as important for participants, but when the device would not accurately record their data, they found it to be upsetting (Edwards et al., 2014). This showcases the effect activity monitoring devices have, and could impact the amount of exercise performed by users.

The encouragement of healthy eating habits included persuasive principles such as: self-monitoring, simulation, rewards, reminders, social comparison, and competition. The main suggestion for a mobile application provided by the participants was to include social media, even though it already contained social support features (Kroes & Shahid, 2013). This showcases how social influence is highly regarded as

persuasive for games centered around healthy eating. It can be beneficial to include teams or group activities in dietary health games, as they encourage more social interaction and can enhance the principles within social support (Katule, Rivett, & Densmore, 2016). Simulation was one of the most effective principles for this sector, as it presents the negative outcomes that might happen when consuming unhealthy food (Kroes & Shahid, 2013). Reminders were also appreciated and considered to be a trigger to perform target behavior (Kroes & Shahid, 2013). More research can be focused on how to maintain these habits (more information on this in the health management segment), as natural consequences were seen as motivating to one child that could feel their digestion improving (Joi et al., 2016).

The principles that facilitated health management through games include: tunneling, personalization, self-monitoring, praise, rewards, suggestion, and similarity. The study conducted by Henkemans et al. (2017) included principles of personalization, praise, suggestion, and similarity. The results of this study display that children prefer personalized interactions, and are more likely to be motivated, engaged, and pleased with their experience. They also demonstrate their susceptibility to learning when these three aspects are fulfilled, which would lead to knowledge growth and improved self-management. Tunneling, self-monitoring and rewards were used in a study that was successful in maintaining learned skills one week after the study was conducted (Chang et al., 2008). These principles can be included in future studies that will occur for an extended period of time.

In order to improve behavior in educational settings, the most notable features would be normative influence, competition, and rewards (Reis & Correia, 2011). Some students were not as motivated to engage in the target behavior because a character that was a part of the game was perceived as boring. It can be inferred from this result that children must have an interest in the persuasive features, otherwise it will be less effective. Principles included in games with the purpose of teaching something include: reduction, tunneling, simulation, rewards, and social comparison. Simulation was one of the strongest principles, with multiple studies showcasing that it is successful in helping participants learn through games. For example, most of the students that participated in a natural disaster educational game were documented to have

productively learned and understood the methods of flood protection (Tsai et al., 2015). It also had an influence to change players' attitudes Ruggiero (2018) The principles of reduction, tunneling, rewards, and social comparison were stimulants of motivation for participants to study the materials within the game (Elaish et al., 2019). Studies that focused on smoking prevention used principles of reduction, self-monitoring, rewards, simulation, praise, social comparison, and competition. A study that proved effective in transmitting knowledge included reduction, rewards, simulation, and praise (Lakovic, 2020). In addition to gaining knowledge, principles of self-monitoring, rewards, social comparison, and competition resulted in participants providing an averaged score of 4.28 on a Likert scale ranging from 1 to 5 (Guo et al., 2021).

The most consistent PSD component was social support, which was perceived as persuasive in almost all the studies that incorporated it. Games that are able to include social support within their system would greatly increase the likelihood of persuasion. The most powerful features from primary task support include personalization, self-monitoring, and simulation. Features that embodied these principles were able to keep the engagement of the players, self-evaluate their performance to improve it, and apply aspects from the games to their lives. Dialogue support principles that were consistently appreciated by participants include praise, reminders, and rewards. The positive feedback and incentives were generally motivating, and reminders would trigger target behavior. Overall, games that include the most prominent features from all components based on the target attitudes and behaviors, as well as the identified sector, the system will be significantly persuasive.

There are a few limitations to keep in mind when considering the results. Persuasive technology is usually embedded in some sort of device. Technological difficulties would occur in some of the studies, and this would affect the influence of persuasion and interrupt either the motivation or ability to continue. Several papers did not include data that showed a direct effect between playing the game and the participants' attitudes or behavior, so it could not be inferred that these characteristics would work to persuade them. Using measurement scales to provide more information of the effects of persuasion would be useful to make more accurate conclusions in subsequent studies. Another major limitation is the duration of the studies. Many of

them did not exceed one day, and the ones that did were only a few weeks long. There were no long-term studies that could truly support the sustentation of the attitudes or behaviors that were measured. This is especially important when taking the novelty effect into account. The novelty effect is the period of time that participants can find a new game or app interesting, and the amount of use is substantial. But when this feeling subsides, the use decreases drastically. The long-term effects of the games can't be properly evaluated because the novelty effect would not have the time to recede. Future studies should consider elongating the length of time in order to explore these aspects.

7. Bibliography

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